

## CHAPTER 3

# THE COMMISSIONING PROCESS

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### 3-1 General

The commissioning process should be initiated in the program phase of a project and completed after the post-functional performance phase. As part of this process a commissioning plan needs to be prepared. The plan should address the specific objectives, details, and parties involved in each individual project.

*a. Commissioning plan.* The commissioning process applies to all phases of a facilities life-cycle and can be applied throughout the life of fixed ground-based threat hardened Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) facilities. A commissioning plan shall be prepared and shall provide for all activities associated with commissioning. These activities include the following.

- (1) Developing a design basis document.
- (2) Establishing the commissioning team and their responsibilities.
- (3) Listing the systems involved.
- (4) Providing for project cost and schedule impact resulting from commissioning activities.
- (5) Providing a pre-functional test plan with procedures for testing each system.
- (6) Providing an functional performance test plan with system test procedures including deferred test procedures for each system.
- (7) Providing a corrective action plan with procedures.
- (8) Providing a commissioning documentation filing procedure.
- (9) Providing a commissioning tracking procedure.
- (10) Providing requirements for a commissioning final report.
- (11) Providing training modules for the operating and maintenance (O & M) staff on each system.
- (12) Providing a training plan and procedures.
- (13) Providing a system manual for each mechanical system.
- (14) Recommending test and calibration equipment for first and second echelon maintenance.

*b. Commissioning process.* Additional information on the commissioning process is found in American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): Guideline

1-1996, The HVAC Commissioning Process, the Department of Energy: Building Commissioning Guide, Version 2.2, and the Department of Energy: Model Commissioning Plan and Guide Specifications, USDOE, Version 2.05.

### **3-2. Commissioning applicability to project phases**

All phases of a facilities life cycle should be addressed in a commissioning plan. The requirements to be addressed in the plan for each phase are discussed below.

*a. Program phase.* During the program phase certain tasks need to be accomplished to initiate the commissioning process. These tasks are part of the commissioning plan and include the following activities.

(1) Establish a commissioning team. This team needs to have a representative from quality control; the mechanical contractor; the electrical contractor; the testing, adjusting and balancing (TAB) contractor; the controls contractor; the design agent; the contracting officer; and the using agency.

(2) Define the responsibilities of each team member.

(3) Establish the team member with authority to coordinate the commissioning process, the commissioning authority (CA).

(4) Develop a list of the systems involved. This is the first step in preparing a system manual for each system.

(5) Prepare a design basis document to document commissioning requirements. The requirements establish what is needed by the owner and therefore what is to be obtained from commissioning activities in the project. They establish the desired goal of commissioning which is to provide the facility manager information necessary to achieve, verify, test, accept, and document that the performance of mechanical systems meet design intent and the owner and occupant needs. Included in the design basis document is weather data, interior environmental criteria, other pertinent design assumptions, cost goals, and references to applicable codes, standards, regulations, and guidelines.

(6) Discuss possible impact resulting from commissioning activities. The commissioning process will require human resources, materials, and equipment to be implemented.

(7) Plan for the total impact of commissioning. Planning needs to include the impact on schedule, equipment, facility, manpower, documentation, supplies, expendables, cost, and objectives of the project.

*b. Design phase.* For continued development of the commissioning plan, the following needs to take place during the design phase.

(1) Review and update the design basis document.

(2) Confirm the systems involved as design progresses as the systems, equipment, components, instruments, and their particulars will change during design. The commissioning plan needs to be updated as applicable systems change.

(3) Establish pre-functional testing criteria defining the checks and inspections of system equipment and components which need to take place before functional performance testing can start.

(4) Develop the pre-functional test plan and include a pre-functional test procedure for each system using the criteria established above. The procedures include checks and inspections which need to be conducted to insure that the equipment, components, instruments, and entire system is ready for functional performance testing. Procedures need to include forms indicating test results, deficiencies found, dates and signature sheets, and any other documents needed to authorize commissioning of the system. A comparison of the installed system against design schematics and piping and instrumentation diagrams (P&ID), and a review of as-built documents needs to be included in the procedures.

(5) Define functional performance testing criteria for mechanical system equipment and components during this phase as the technical aspects of the mechanical systems are being established at this time and the resources to develop this criteria are readily available.

(6) Develop the functional performance test plan using the criteria established above. Functional performance test procedures for each system must be prepared. The functional performance test with sign-off authorization is required for official system acceptance by the CA. The functional performance test plan incorporates all functional performance test procedures including deferred functional performance test procedures. Procedures need to include forms indicating test results, deficiencies found, dates and signature sheets, and any other documents needed to authorize acceptance of the system.

(7) Identify deferred functional performance test procedures and include them in the functional performance test plan. Functional performance tests which require seasonal conditions or startup of other systems as prerequisites need to be deferred until the conditions are met and/or the systems are available and functioning properly. Once systems requiring deferred tests are identified, a deferred functional performance test procedure needs to be prepared for each and included in the functional performance test plan. Procedures need to include forms indicating test results, deficiencies found, dates and signature sheets, and any other documents needed to authorize acceptance of the system.

(8) Define recommended test and calibration equipment for first and second echelon maintenance needs. This equipment is most easily defined during the design phase because the technical aspects of the mechanical systems are being established at this time and technical resources are readily available.

(9) Develop a corrective action plan to handle pre-functional, functional performance, and deferred functional performance testing deficiencies discovered during commissioning. These deficiencies need to be recorded, corrective actions taken, corrective actions verified/approved, and final functional performance authorized. Procedures in this plan will establish responsible individuals and will provide the methods and documentation needed to process the deficiency identified in testing through all steps until its correction is authorized as approved. These steps may include interim measures or immediate actions needed for safety or to prevent damage to equipment. Procedures in the corrective action plan will define how acceptance is finally authorized against functional performance and deferred functional performance test procedures.

(10) Develop a commissioning documentation filing procedure to retain commissioning process plans, procedures, tests, test reports, corrective actions, verification reports, tracking reports, training modules, training status reports, other status reports, deficiencies, the final commissioning report, and many forms, reports, drawings, sketches, signature sheets, sign-offs, and other documents for all systems

at all phases and steps in the process. This procedure will provide a method of filing/retaining/retrieving documents and a schedule for their retention. It will also establish the individual having authority for the system and location and conditions of storage.

(11) Develop the commissioning tracking procedure as part of the commissioning plan to track the status of all commissioning plans and procedures, tests, test reports, corrective actions, verification reports, tracking reports, training modules, training status reports, other status reports, deficiencies, the final commissioning report, and any forms, reports, drawings, sketches, signature sheets, sign-offs, and other documents for all systems at all phases and steps in the process. This procedure will track all activities and documents in the commissioning process and at any time provide readily generated reports on the status of any item, system, or process.

(12) Develop the commissioning final report outline and include an introduction; description of the facility; purpose of commissioning facility systems; description of how through commissioning the requirements of the design basis document have been achieved; summary of commissioning activities; summary of commissioning results; and official authorization that the facility has been turned over to the owner to be managed by the facility manager. The report shall have a signature page.

(13) Develop training modules for the O & M staff as part of commissioning training. Training modules on maintenance and operation must be prepared for each system.

(14) Develop the training plan in order to insure that O & M staff are properly trained on mechanical systems and that their training remains current. For the purpose of commissioning and the systems involved, procedures are needed for defining training requirements, developing modules, updating training modules, conducting training, tracking the status of trained staff and modules, and maintaining current training modules and records for each system. These procedures need to be prepared during the design phase and included as part of the training plan.

(15) Prepare an initial system manual for each mechanical system. Each system manual shall include a drawing and equipment list; drawings; equipment specifications; and manufacturers' equipment installation, maintenance, and operating instructions.

(16) Adjust the project's schedule and cost resulting from development and refinement of commissioning activities. The impact on the project must constantly be adjusted for changes resulting from commissioning activities as the commissioning process evolves.

*c. Construction phase.* Most of the commissioning activities defined in the design phase can be conducted in the construction phase, however, the technical staff required is more readily available in the design phase. Based on as-built systems the following needs to be confirmed in the construction phase.

- (1) Design basis document.
- (2) List of systems involved.
- (3) Pre-functional test plan and procedures.
- (4) Functional performance test plan and procedures.
- (5) Deferred functional performance test procedures.

- (6) Recommended test and calibration equipment for first and second echelon maintenance.
- (7) Corrective action plan.
- (8) Commissioning documentation filing procedure.
- (9) Commissioning tracking procedure.
- (10) Commissioning final report outline.
- (11) Training modules for the O & M staff.
- (12) Training plan.
- (13) Commissioning team and responsibilities.
- (14) Contents of system manuals.

(15) Impact to the projects schedule and cost resulting from development and refinement of commissioning activities and construction activities must be accounted for with revised schedules and costs.

*d. Functional performance phase.* The functional performance phase is when tests are conducted and results recorded. Some overlap may be possible allowing pre-functional tests to be conducted as systems are completed and as-built documents are being prepared. Functional performance tests may be conducted on some systems as construction on other systems is being completed. After completion of the functional performance phase the project is closed. Mechanical systems necessary for immediate operation of the facility have been functional performance tested and signed off. The facility will be turned over to the owner with some exceptions. Completion of some deferred tests, some guarantee/warranty work, and/or some corrective actions may remain to be conducted in the post functional performance phase. During the functional performance phase the following needs to be implemented.

- (1) Pre-functional test plan and procedures.
- (2) Functional performance test plan and procedures.
- (3) Deferred functional performance test procedures.
- (4) Corrective action plan.
- (5) Commissioning documentation filing procedure.
- (6) Commissioning tracking procedure.
- (7) Commissioning final report preparation – first draft.
- (8) Training of the O & M staff.

- (9) Training plan.
- (10) Review of the design basis document.
- (11) Preparation of system manuals.

*e. Post-functional performance phase.* The post-functional performance phase may take up to one year after project-close-out occurs. Final functional performance comes at completion of the post-functional performance phase. Tests conducted for re-commissioning are conducted after the post-functional performance phase of the commissioning process to re-confirm the readiness of systems or modified systems to meet their design or modified design intent. To conduct re-commissioning activities, commissioning activities on the original facility must be complete. To conduct retro-commissioning activities, a facility which has been in operation but never commissioned must go through the commissioning process. Post-functional performance includes the following.

- (1) Completion and functional performance sign-off of remaining deferred tests, guarantee/warranty work, and/or corrective actions.
- (2) Implementing the commissioning documentation filing procedure.
- (3) Preparing the commissioning final report – final draft.
- (4) Issuing the commissioning final report.
- (5) Completing training of the O & M staff.
- (6) Implementing the training plan.
- (7) Preparation of an updated/revised final design basis document.
- (8) Preparation of final system manuals.